Air Quality Conditions and Trends in Parks – Annual Report 2004

FY 2004 Annual Performance Report: Government Performance and Results Act (GPRA)
Air Quality Goals Ia3, Ia3B (DOI# PEM.1.010), and Ia3C (DOI# PEM.1.011)
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The National Park Service (NPS) Air Resources Division (ARD) recently completed its FY 2004 performance assessment for the Government Performance and Results Act (GPRA). The long-term Air Quality Goal Ia3 states that by September 30, 2008, air quality in 70 percent of reporting park areas has remained stable or improved. The planned FY2004 performance target was 62 percent of reporting park areas with stable or improved air quality by September 30, 2004. Our recent servicewide assessment for FY2004 indicated a performance measure of 63 percent, thus exceeding our target goal. The results of the trend analyses for the various measures appear in Table 1; Figure 1 depicts trends geographically for all parks and indicators, and Figures 2-7 depict trends for each indicator. A park is considered to have improving or stable air quality if none of the six measures show a statistically significant degrading trend (denoted in red on the table and figures). This year, a couple measures were modified, as was the procedure used to determine whether park air quality has remained stable or improved.

Performance Indicators

This air quality assessment is based on a 10-year trend of three performance indicators: visibility, ozone, and wet deposition. Six measures are used to assess performance under the three indicators. For visibility, particle measurements made at 30 NPS units were used to calculate the annual reconstructed atmospheric extinction in deciview for both clean and dirty days. (Extinction depends on the mass and chemical composition of the particles and is a quantitative measure of how the passage of light through the atmosphere is affected by air pollutants.) The ozone measure was modified in FY 2004 to correspond to the new national ambient air quality standard (i.e., the 3-year average of the annual fourth highest daily maximum 8-hr ozone concentration) and has been calculated at 32 NPS units. Finally, for acid deposition, annual precipitation-weighted means of sulfate, nitrate, and ammonium ion concentrations at 29 NPS sites were used to gauge air quality for this indicator. Changes in ammonium ion concentration in precipitation were included in the wet deposition indicator this year because ammonium contributes to total nitrogen deposition and data indicate that ammonium concentrations are increasing at a faster rate than nitrate ion concentrations alone.

The method used to determine statistical significance of trends was also modified this year to use a value more commonly used in the literature. In past trend reporting, we had used a significance level of 0.15, meaning there was a 15% chance that we could wrongly conclude that there was a trend when in fact the change was due to chance. We have decided to change the significance level to 0.05, which is commonly used by many researchers. This reduces the chance that we would incorrectly conclude that there is a trend from 15% to 5%.

To calculate a servicewide percentage to compare with the air quality goal, we first performed a trend analysis for each of the above six air quality measures (2 visibility, 1 ozone, 3 acid precipitation) over a ten year period. The FY2004 analysis used 1994-2003 data and required each site to have a minimum of at least six years of data in this ten-year period. (Year 2004 data were not used in this FY2004 analysis because all of that year's data were not available. There is typically at least a three to six month lag between the time the data are collected in the field and when they are validated and available for analysis.) Our trend time period is a sliding 10-year window and will change to 1995-2004 for next year's analysis. Computing trends during a sliding 10-year window was employed rather than tracking changes from a single fixed baseline year because each park often began its visibility, ozone, or acid deposition monitoring during different years and there was no single fixed baseline year from which to track changes at all parks.

Trend Analysis Results

The results of the trend analyses for the six individual measures appear in Table 1. A park is considered to have improving or stable air quality if none of the six measures show a statistically significant degrading trend (denoted in table 1 with a red box). The tabulated values include the slope or change in the measure per year and a level of statistical significance (p-value). Slopes with p values at 0.05 or less are considered statistically significant. The number of NPS areas not showing statistically significant deterioration in any of the performance indicators at the 0.05 level of significance is then divided by the total number of NPS units with monitoring to calculate a systemwide percentage which is then compared to the performance measure of the GPRA goal. For FY2004, 31 of 49, or 63% of NPS parks with monitoring showed stable or improving trends. Thus, the annual air quality performance goal was met for this year.

Trend results for all parks and indicators are represented in Figure 1. Figure 2 through Figure 7 present maps illustrating the results of the individual trend analyses for ozone, visibility and acid deposition. The solid green and red arrows represent statistically significant improving or degrading trends during 1994-2003, while the light green and yellow arrow symbols represent similar trends but not statistically significant with p values between 0.05 and 0.15. These last two symbols are included to indicate which parks had trends that would have been considered statistically significant under the procedures used in past years.

A statistically significant degrading trend in ozone was observed at two eastern sites-- Acadia National Park and Congaree National Park. (Figure 2.) In the west, eight sites – Canyonlands, Craters of the Moon, Death Valley, Grand Canyon, Mesa Verde, North Cascades, Rocky Mountain, and Yellowstone -- showed increasing ozone air pollution trends, while levels at Channel Islands, Saguaro, and Sequoia National Parks showed improving ozone trends. The trend toward increasing ozone at Intermountain West monitoring sites has been observed for several years. Sixty nine percent of reporting park ozone monitors (22 of 32) showed stable or improving trends. This percentage was the lowest of any of the six performance measures and was the driving factor for the overall goal percentage not being higher than 63%.

Only Acadia National Park showed a statistically significant improving visibility trends for clean days at eastern national park monitoring sites. (Figure 3.) Acadia also had an improving trend on dirty visibility days, as did Great Smoky Mountains and Mammoth Cave National Parks, and Washington D.C. (Figure 4.) Statistically significant improving trends for clean visibility days were observed at 9 sites in the northwest U.S., California, Colorado Plateau, and Rocky Mountain areas, and Alaska. Great Sand Dunes National Park was the only NPS site to have a significant worsening trend on the best visibility days. Three sites in Arizona, Colorado, and Texas documented significantly degrading dirty day visibility trends. The percent of reporting park visibility monitors showing stable or improving trends was 97% for clean days (29 of 30 parks) and 90% (27 of 30) for hazy days.

No NPS monitoring site in the East or West demonstrated a statistically significant worsening trend in sulfate ion concentrations in precipitation. Thus, 100% of reporting park wet deposition monitors (29 of 29) showed stable or improving trends for sulfate in precipitation. (Figure 5.) Indiana Dunes and Mesa Verde had statistically significant improving sulfate trends. Western deposition monitoring sites show rising nitrate ion concentrations. (Figure 6.) Bandelier, Gila Cliff Dwellings, and Organ Pipe Cactus National Monuments and Glacier National Park showed statistically significant worsening nitrate trends. Eighty six percent of reporting park wet deposition monitors (25 of 29) showed stable or improving trends for nitrate in precipitation.

Spatial trends in ammonium ion concentration are similar to those for nitrate. (Figure 7.) Little Bighorn Battlefield, Bandelier, and Gila Cliff Dwellings National Monuments and Rocky Mountain and Canyonlands National Parks exhibited statistically significant worsening trends in ammonium ion concentrations. Eighty three percent of reporting park wet deposition monitors (24 of 29) showed stable or improving trends for ammonium in precipitation.

Department of the Interior Strategic Plan Air Quality Goals

The National Park Service Air Resources Division also reports to two servicewide air quality goals in the Department of the Interior (DOI) strategic plan. One goal, Ia3B (DOI# PEM.1.010), deals with ambient air quality standards, while the other, Ia3C (DOI# PEM.1.011) involves meeting visibility objectives in Class I areas. (Class I areas, as defined in the Clean Air Act, include all national park units over 6000 acres established by August 1977, plus any additions to those units.)

For FY2004, goal Ia3B was achieved. The goal states that by September 30, 2004, 69% of reporting NPS Class I areas meet national ambient air quality standards (NAAQS). For this fiscal year, 75% or 27 of 36 reporting NPS Class I areas met NAAQS. Nine of the 36 NPS Class I areas either have measured levels of ozone, particulate matter (PM2.5), or sulfur dioxide above the level of the NAAQS or don’t but are all or in part included in EPA designated non-attainment areas for those pollutants. (Figure 8.) NPS Class I areas with monitored ozone levels above the level of the NAAQS and in EPA non-attainment areas include Acadia, Great Smoky Mountains, Joshua Tree, Sequoia/Kings Canyon, Shenandoah, and Yosemite National Parks. Rocky Mountain NP has monitored ozone levels below the level of the NAAQS but is part of an EPA ozone non-attainment area. Point Reyes does not have onsite ozone monitoring but is part of an EPA designated ozone non-attainment area.

For PM2.5 particulate matter, no NPS Class I area with monitoring exceeds the level of the standard but the following four NPS areas are all or part in EPA’s PM2.5 non-attainment areas: Great Smoky Mountains, Joshua Tree, Sequoia/Kings Canyon, and Yosemite National Parks.

Sulfur dioxide levels at Hawaii Volcanoes NP occasionally exceed the level of the NAAQS. Such exceedances of the standard are caused by natural volcanic, and not anthropogenic, emissions.

For FY2004, the visibility goal Ia3C was also met. This goal states that by September 30, 2004, 66% of reporting NPS Class I areas meet visibility objectives. For FY2004, 85% of reporting NPS Class I areas met visibility objectives. Meeting visibility objectives occurs when “reasonable progress” is made toward achieving EPA’s regional haze regulation goal of restoring natural background visibility conditions over a 60-year period. The definition of reasonable progress will differ for each class I area because both existing baseline visibility conditions and target natural background visibility conditions differ from area to area.

The states are responsible for developing plans to implement the regional haze regulations and track the progress toward meeting the natural background visibility goal. States are required to assess incremental progress toward meeting that goal every five years and revise their implementation plans every 10 years to incorporate revised or new strategies to continue to make progress toward meeting the goal.

States will not submit their plans to implement regional haze regulations until 2007 or early 2008. In the absence of published visibility objectives based on approved state regional haze control plans, a surrogate visibility objective is being used by NPS for reporting under this goal. The NPS visibility objective will be that "visibility in reporting NPS Class I areas has remained stable or improved". The surrogate visibility objective used by NPS for this DOI goal is thus a subset of the measure used for NPS air quality goal Ia3 which is applied to all parks with monitoring regardless of their air quality class designation. A reporting NPS Class I area's visibility has remained stable or improved if the area has not experienced a statistically significant deterioration in both clear and hazy day visibility in the most recent 10-year period measured, at the 0.05 level of significance.

NPS will revise the visibility objectives used in this goal as the implementation of the regional haze regulations proceeds. This revision of the visibility objectives would probably occur during the next NPS strategic plan.

Twenty two of 26 reporting park Class I areas had visibility that remained stable or improved during the ten-year period 1994-2003. The four class I parks that did not meet this goal were Great Sand Dunes, Guadalupe Mountains, Mesa Verde, and Petrified Forest National Parks. This actual goal performance is higher than planned (85% vs. 66%) because the criterion for determining whether the visibility trends are statistically significant was changed in 2004 from 0.15 to 0.05, in order to use a value more commonly used in the scientific literature. Had this criterion been kept at 0.15, the actual performance still would have exceeded the performance goal (69% vs. annual target of 66%). The annual targets for FY2005 to FY2008 have been increased because of this change in the statistical significance level.

Improving Performance: Actions Being Taken to Meet Air Quality Goal

Making progress toward meeting the GPRA air quality goals is challenging because the NPS has no direct authority to establish air quality standards or control sources of pollution located outside park boundaries. Given its consultative role, the NPS must rely on providing credible and timely information and collaborating with regulatory agencies and stakeholders to bring about pollution reduction and fully protect park resources. Strategies used by the NPS to facilitate meeting park air quality objectives are summarized below:

Promote and support national, regional, and state regulatory initiatives to reduce air pollutant emissions

During the past couple of years, the NPS has supported national efforts to reduce emissions from mobile sources, including diesel engines and fuel, and to clean up older pollution sources operating without modern, efficient pollution controls. For example, the NPS provided:

- Information to EPA, including testimony and formal comments, in support of the proposed Clean Air Interstate Rule (CAIR) and other requirements for installing best available retrofit technology on major sources contributing to visibility impairment in Class I areas. These proposals, if finalized, will bring about significant reductions in SO_2 and NO_x emissions by 2013-2018, with anticipated improvements in air quality in parks. We also provided information in support of EPA's proposed non-road diesel regulations, which will substantially reduce sulfur emissions from engines.

- Expert assistance to the Department of Justice which has been using courts and mediators to achieve similar results at sources with potential compliance issues. For example, the NPS collaborated with DOJ on cases involving Virginia Electric Power/Dominion Electric and Ohio Edison. These companies operate power plants that are major contributors to visibility impairment and acid deposition at Shenandoah NP. Other parks and wilderness areas in the eastern U.S. will also benefit from the negotiated pollution reductions. The ARD will continue to provide assistance to DOJ as it pursues cases against other sources.

- Information about ozone levels in parks to assist with EPA's designation of ozone "nonattainment" areas. In 2004, EPA finalized a list of those areas in the country that are not attaining the National Ambient Air Quality Standard for ozone. The 474 counties associated with the listed "nonattainment" areas include all or part of 106 NPS units, of which 8 are Class I air quality parks. The Air Resources Division will continue to work with States and EPA to bring these areas into attainment as expeditiously as possible.

In the interim, during the summer of 2004, there were significant reductions in nitrogen oxide emissions in 20 states throughout the East and Midwest, as a result of a 1998 EPA regulation. The NPS submitted information and comments in support of this rule several years ago. Most of the emissions reductions needed to meet these plans will come from urban and rural electrical generation facilities by the application of retrofit technology.   This reduction should lead to less formation of ozone and nitrate and, by reducing oxidants in the atmosphere, should lead to lower formation of sulfate as well. These expected outcomes will provide additional contributions to meeting the NPS GPRA air quality goal.

Reviewing permit applications for new or modified sources of pollution locating near parks

The Prevention of Significant Deterioration (PSD) program identified in the Clean Air Act gives the Federal Land Manager and park superintendents an affirmative responsibility to protect air quality related values (AQRVs) including visibility of Class I areas. Whenever a major new or expanding source of air pollution wishes to locate near a Class I area, the NPS must assess whether its emissions would cause or contribute to an adverse impact on AQRVs. NPS' permit review activities involve an engineering analysis of control technology to be applied to minimize emissions, an air quality modeling analysis to determine whether air quality impacts will be within Federal air quality standards and limits, and an AQRV analysis to ensure park resources are protected.

- In FY 2004, ARD reviewed 39 new source permit applications for projects proposing to locate near NPS-managed areas. NPS routinely suggested that the new sources be equipped with better pollution control technology to minimize emissions, thereby reducing impacts on NPS areas. NPS also conducted independent dispersion modeling analyses to help ensure that the proposed new sources would not adversely impact visibility and other air quality related values at NPS units.

- A major success in 2004 was the development of a mitigation plan for the proposed Longview power plant in West Virginia. The Department of the Interior had determined that the plant would have an adverse impact on visibility and aquatic resources at

Shenandoah National Park. Since this determination was issued, the National Park Service, US Forest Service, and several environmental groups worked with the West Virginia Division of Air Quality to develop a mitigation plan that may serve as a model for resolving similar situations elsewhere. The mitigation plan, which includes emission offsets, will not only protect the resources of Shenandoah National Park from any significant impact by Longview upon PSD increment, visibility, or aquatic health, but may also enhance air quality in the region.

- ARD has continued to collaborate with EPA and states to develop improvements to the New Source Review (NSR) and PSD programs. NPS has striven to clarify the roles and responsibilities of the source owner, permitting authority, and NPS, and the time frames for reviews of permit applications for sources potentially affecting air quality near Class I areas. These changes, if implemented, would reduce delays and disputes associated with permit applications for sources near Class I areas because they would ensure that the NPS obtains the necessary information to conduct their permit reviews in a timely manner and provide a time frame for the NPS to identify any concerns and analyses needed for the permit applications.

Consensus-building with States and Tribes, the Environmental Protection Agency (EPA), Regional Planning Organizations, and other stakeholders in the development of cost effective strategies to reduce and prevent air pollution

- Air quality issues in western Class I areas prompted western state and federal air quality agencies to initiate a collaborative effort aimed at creating a more comprehensive approach to manage and protect clean air. There is a shared recognition of the need for better management of the clean air resource and the value of protecting AQRVs in Class I areas. Agreement has been reached on a framework for conducting periodic reviews of cumulative impacts of incremental changes in air quality and responding to problems. Discussions are ongoing regarding similar approaches for protecting AQRVs in Class I areas. As part of this effort, the ARD is supporting the development and use of alternative metrics for gauging ecosystem health. For example, defining air quality objectives based on critical loads for deposition of sulfur and nitrogen is one such alternative being considered. (The critical load is the threshold deposition of pollutants at which harmful effects on sensitive receptors begins to occur.)

- Multi-state regional planning organizations are coordinating planning efforts and facilitating the implementation of the Regional Haze regulations. The ARD, with substantial assistance from park and regional air quality specialists, is actively participating in regional partnerships that have been formed for the Northeast (Mid-Atlantic/Northeast Visibility Union), Southeast (Visibility Improvement States and Tribal Association of the Southeast), Midwest (Midwest Regional Planning Organization), Central States (Central States Regional Air Partnership), and the West (Western Regional Air Partnership). We have shared NPS monitoring data with these groups, assisted with data analyses and interpretation, and ensured that the NPS management objectives of promoting and pursuing measures to safeguard park resources and values will be considered by securing a seat at the table. States must submit plans implementing the regional haze regulations by the end of 2007. Subsequent plan reviews and revisions for all states will occur in 5-year intervals with the goal of achieving no human-caused impairment to visibility in the nation’s 156 mandatory Class I areas by the year 2064.

- Several western states have already submitted State Implementation Plan (SIP) revision proposals to address regional haze in Class I national parks and wilderness areas on the Colorado Plateau, based on a suite of air pollution control and prevention strategies developed over the past decade through a stakeholder-based, consensus-building process. The NPS played an instrumental role in this process, and subsequently lent support to states wishing to adopt these strategies through state rulemaking processes. A second round of SIP revisions will be required in 2008 to ensure that reasonable progress is being made to improve visibility in the Colorado Plateau Class I areas and to address other Class I areas outside this region.

- The Big Bend Regional Aerosol and Visibility Observational (BRAVO) Study final report was released in 2004. The study investigated the long-range transport of visibility-reducing particles from regional sources in the U.S. and Mexico and the contributions of U.S. and Mexican source regions and source types responsible for poor visibility at Big Bend National Park. This study was undertaken by the NPS and the EPA, with participation by the Texas Commission on Environmental Quality and the Electric Power Research Institute. Major findings of the study included that on average during the study period, more than half of the sulfate at Big Bend National Park came from the U.S., in particular from the eastern U.S. and Texas, while Mexican sources contributed about one third. The Carbón I and II power plants in Mexico contributed about one-fifth of the total sulfate measured at Big Bend National Park. Eastern U.S. and eastern Texas sources were the largest contributors to peak particulate sulfate episodes during BRAVO. Mexico and the western U.S. were the largest contributors on the least hazy days during the study period. The data analysis was conducted so that the greater uncertainty in the pollutant emission estimates for Mexican sources would not lead to any significant alteration in the reported relative contributions of each geographic area.

Collecting and widely disseminating information about air quality conditions and trends in parks.

In addition to the long-term air quality monitoring being conducted in 69 parks, data are also being acquired on resources sensitive to air pollution and the causes and effects of pollution, including:

- Special short-term air quality sampling studies were undertaken at Great Smoky Mountains NP (cloud water chemistry), Isle Royale NP (development and testing of monitoring equipment for remote locations), and Yosemite NP (measurement of ozone and its precursors in the Yosemite Valley).

- Mercury monitoring activities were expanded to 10 parks in FY 2004. This monitoring is being conducted in cooperation with the National Atmospheric Deposition Program, Mercury Deposition Network (MDN). With this information, better estimates of the amount of mercury being deposited into the ecosystem and the spatial and seasonal trends can be made. Deposition of mercury into lakes and streams can trigger biological processes that chemically transform mercury into a toxic form that can bioaccumulate in fish and animals. This accumulation can be harmful to both the host and any organism that may consume it.

- Three ecological effects projects were completed this year at Acadia, Great Smoky Mountains, and Sequoia National Parks. In addition, the NPS continued its support of three ongoing multi-year projects to assess the ecological effects of air pollutants in

Rocky Mountain, Big Bend, and Joshua Tree National Parks and initiated two additional ones in Mount Rainier National Park and Indiana Dunes National Lakeshore in FY 2004.

- NPS initiated the "Western Airborne Contaminants Assessment Project" (WACAP) in FY 2002 to determine the risk to ecosystems and food webs in western national parks from airborne toxic contaminants. NPS is concerned about airborne contaminants because they can pose serious health threats to wildlife and humans, as some of these compounds tend to "biomagnify" in the food chain. EPA, USGS, U.S. Forest Service, Oregon State University, and University of Washington are working with the NPS on this assessment. Results for some of the parks are starting to be released. Analysis thus far shows that Semi-volatile Organic Compounds (SOC, also known as persistent organic pollutants [POPs]), are present in snow and water in Sequoia and Rocky Mountain National Parks, and in plants (lichen) in Sequoia.

Audits have been undertaken to inventory park air pollutant emission sources, recommend strategies to reduce or prevent air emissions from park operations, and determine compliance with state and federal air pollution regulations.

- Over the past few years, the NPS has initiated or completed audits of air pollution sources in over 55 parks. Park operations generally comply with air pollution control, permitting, and emission fee requirements. In addition, to reduce air pollution emissions, many parks are currently implementing green strategies, such as alternative transportation measures, use of alternative fuels and vehicles, and fire management practices aimed at preventing the accumulation of woody fuels. The audits have identified and recommended additional green strategies to further reduce emissions from park operations.

- In FY 2004, the emphasis of the park emissions audit program began to change with a new focus on greenhouse gaseous pollutants associated with climate change. Effects of climate change may be particularly noticeable in national parks because of their locations and unique, protected resources. Maintaining these resources requires practicing good stewardship within parks and on regional and global scales. Through the Climate Friendly Parks (CFP) initiative, the NPS aims to be a leader in demonstrating sustainable stewardship practices within parks and educating the public about them in all park areas. CFP workshops were conducted at Gateway National Recreation Area, and Glacier and Zion National Parks. These workshops provided audits of greenhouse gas emissions as well as action plans that give a framework for achieving emission reductions.

Information about air quality in parks continues to be disseminated through various channels.

- The ARD web site (http://www2.nature.nps.gov/air) was completely redesigned in 2004 and virtual visitation increased by 600% (around 8 million visits in 2003, jumped to almost 55 million in 2004). The site has a much improved interface that provides an inviting portal to a great amount of information and data pertaining to air quality in the national parks. Visitors should now be able to more easily find information on the site.
    - Much of the information and ways of accessing data are new, including new modules such as ARIS, the Air Resource Information System, that contains air quality and air quality related values information for the 48 NPS Class I air quality areas. (http://www2.nature.nps.gov/air/permits/aris/index.htm)

  - One of the most popular features is the web cameras operated at 14 parks to help the public understand and see air quality issues affecting parks. (http://www2.nature.nps.gov/air/webcams/) These cameras often show the effects of air pollution such as visibility impairment. Because these cameras are typically located near air quality monitoring sites, the camera web pages display other information along with the photo such as current levels of ozone, particulate matter, or sulfur dioxide air pollutants, visual range, and weather conditions.
- The ARD continues to provide technical support to parks wishing to develop air quality-related interpretive or public awareness programs, including exhibits, site bulletins, and air quality alert systems.

Environmental planning and compliance

The ARD has provided more specialized and intensive service to parks engaged in environmental planning where air quality is an affected resource (e.g., Yellowstone Winter-use Management Plan and fire management plans). In addition, the ARD has worked with parks and regional office staff in the review of planning documents related to energy development in the West (i.e., oil, gas, and coal-bed methane development), as well as served on various task groups to mitigate impacts associated with this development.

These are some of the activities we are engaged in to make progress toward meeting the GPRA air quality goal. The information, expertise and management concerns that the NPS brings to many external decisionmaking arenas have made a difference in the past and will continue to in the future.

Table 1. Individual Park 1994-2003 Trend Results

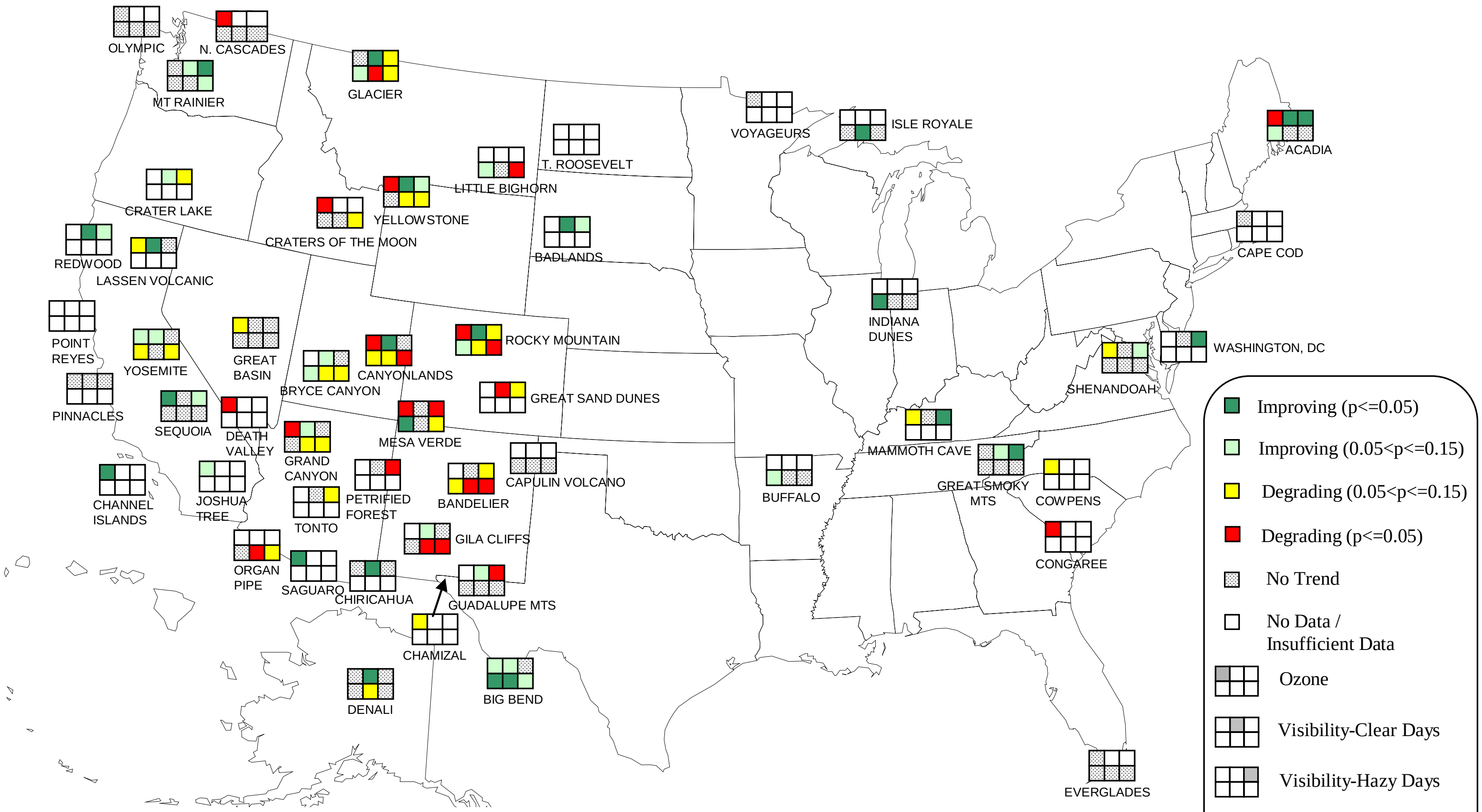
Parks in red do not meet the NPS Air Quality Goal Ia3	Visibility				Acid Precipitation						Ozone	
	Clean Days		Dirty Days		Ammonium		Nitrate		Sulfate		Average 3-Yr 4th High 8-Hour	
	dv/yr	p-value	dv/yr	p-value	µeq/liter/yr	p-value	µeq/liter/yr	p-value	µeq/liter/yr	p-value	ppb/yr	p-value
Acadia	-0.19	0.00	-0.09	0.02	-0.11	0.50	-0.12	0.43	-0.72	0.08	0.83	0.00
Badlands	-0.12	0.04	-0.11	0.08								
Bandelier	-0.03	0.30	0.08	0.15	0.84	0.01	0.78	0.02	0.28	0.13		
Big Bend	-0.20	0.09	0.01	0.45	-0.85	0.13	-0.66	0.02	-1.09	0.02	-0.50	0.05
Bryce Canyon	-0.08	0.08	0.01	0.43	0.71	0.05	0.39	0.09	-0.35	0.14		
Buffalo					0.00	0.57	0.16	0.36	-0.38	0.08		
Cape Cod											0.00	0.43
Canyonlands	-0.17	0.02	0.06	0.19	2.77	0.01	1.84	0.07	0.38	0.14	0.78	0.00
Capulin Volcano					0.13	0.36	0.55	0.36	0.04	0.50		
Chamizal											0.80	0.05
Chiricahua	-0.15	0.00	0.10	0.24							0.00	0.24
Channel Islands											-1.25	0.00
Congaree											1.43	0.00
Cowpens											0.57	0.15
Crater Lake	-0.16	0.07	0.23	0.12								
Craters of the Moon					0.74	0.11	-0.08	0.36	0.03	0.50	1.00	0.00
Denali	-0.19	0.00	-0.04	0.43	0.07	0.30	0.11	0.15	0.11	0.36	0.40	0.24
Death Valley											0.69	0.01
Everglades					-0.08	0.31	0.08	0.31	0.09	0.38	-0.14	0.43
Gila Cliff	-0.18	0.05	-0.12	0.20	1.11	0.02	0.99	0.00	0.06	0.46		
Glacier	-0.17	0.03	0.20	0.14	0.35	0.08	0.20	0.04	-0.17	0.15	0.29	0.24
Great Basin	-0.06	0.24	0.09	0.24	0.35	0.20	-0.14	0.45	-0.24	0.20	0.37	0.13
Grand Canyon	-0.20	0.06	0.06	0.18	0.33	0.14	0.60	0.05	0.06	0.36	0.78	0.00
Great Sand Dunes	0.07	0.01	0.17	0.15								
Great Smoky Mtns	-0.14	0.15	-0.19	0.01	0.00	0.57	0.03	0.50	0.02	0.50	0.50	0.19
Guadalupe Mtns	-0.08	0.08	0.35	0.00	0.38	0.24	0.18	0.31	-0.32	0.38		
Indiana Dunes					-0.10	0.50	-0.44	0.19	-1.17	0.04		
Isle Royale					0.02	0.54	-0.25	0.00	-0.27	0.24		
Joshua Tree											-1.13	0.15
Lassen Volcanic	-0.17	0.01	0.15	0.30							0.50	0.11
Little Bighorn					0.58	0.00	0.19	0.30	-0.22	0.15		
Mammoth Cave	0.14	0.20	-0.09	0.03							1.40	0.11
Mesa Verde	0.01	0.54	0.35	0.02	0.25	0.08	0.17	0.50	-0.63	0.01	0.78	0.02
Mount Rainier	-0.15	0.06	-0.26	0.02	-0.07	0.14	0.04	0.27	0.26	0.20	-0.23	0.46
North Cascades					-0.02	0.46	0.06	0.31	-0.08	0.38	1.40	0.03
Olympic					-0.02	0.27	-0.03	0.20	0.00	0.55	-0.25	0.24
Organ Pipe					1.07	0.09	1.45	0.03	0.21	0.36		
Petrified Forest	0.00	0.50	0.20	0.04								
Pinnacles	-0.15	0.36	-0.08	0.27							-0.29	0.24
Redwood	-0.20	0.00	-0.21	0.15								
Rocky Mountain	-0.19	0.01	0.11	0.11	0.83	0.01	0.38	0.11	-0.28	0.08	0.75	0.01
Saguaro											-1.00	0.00
Sequoia	0.06	0.50	-0.34	0.14	-0.46	0.36	-0.35	0.36	-0.09	0.36	-1.25	0.02
Shenandoah	-0.14	0.18	-0.22	0.09	-0.11	0.45	-0.20	0.27	-0.27	0.27	0.50	0.05
Tonto	-0.04	0.27	0.13	0.05								
Voyageurs											0.40	0.30
Washington	-0.15	0.13	-0.12	0.04								
Yellowstone	-0.16	0.01	-0.28	0.13	0.64	0.09	0.33	0.09	0.14	0.31	1.00	0.00
Yosemite	-0.15	0.05	0.10	0.24	0.67	0.05	0.24	0.24	0.22	0.08	-0.50	0.11

= Improving air quality trend, statistically significant ($p<=0.05$)
= Degrading air quality trend, statistically significant ($p<=0.05$)
= Improving air quality trend, not significant ($0.05<p<=0.15$)
= Degrading air quality trend, not significant ($0.05<p<=0.15$)

Figure 1

Air Quality Trends in National Parks, 1994-2003

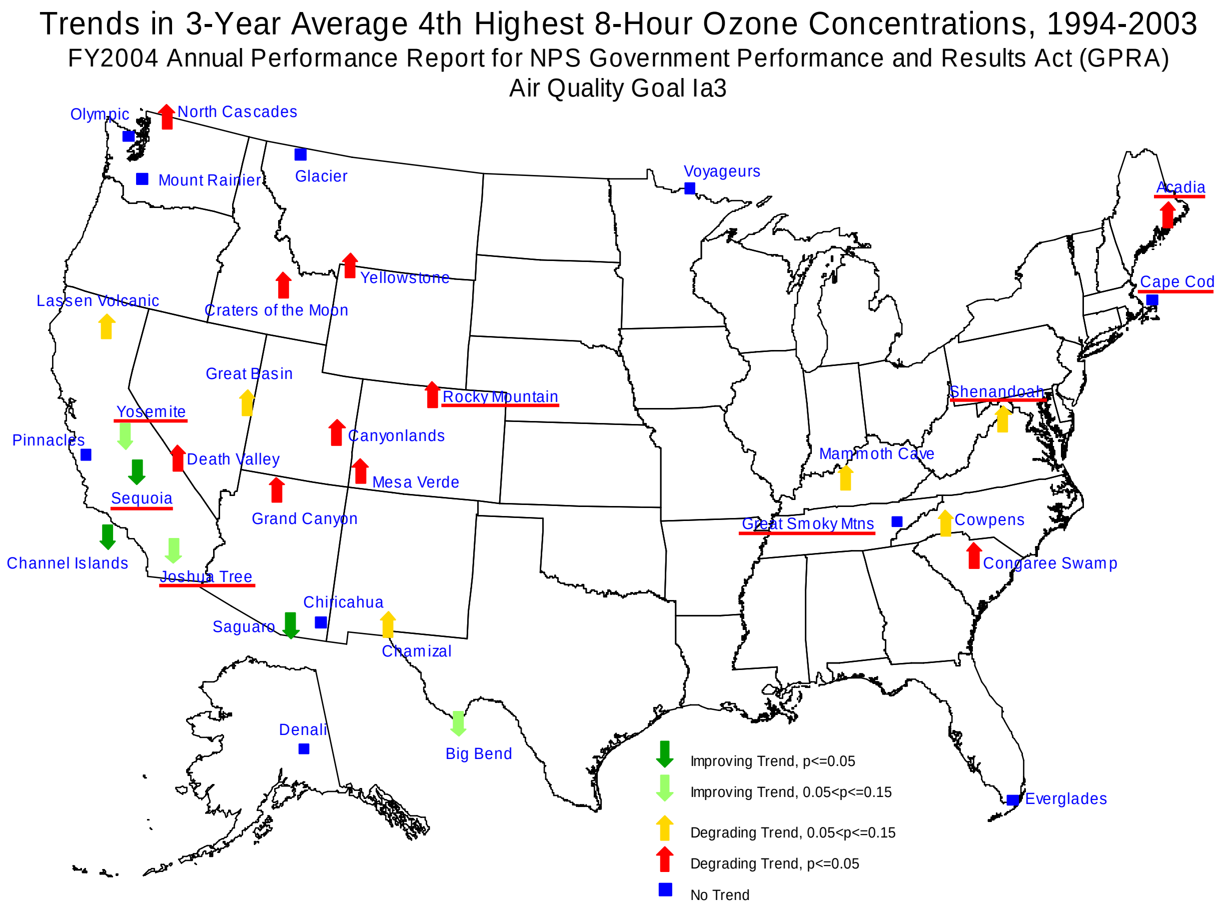
FY2004 Annual Performance Report For NPS Government Performance and Results Act (GPRA) Air Quality Goal Ia3



Colored boxes indicate the existence of air quality trends during 1994-2003. Dark green and red boxes indicate statistically significant improving or degrading trends at the .05 significance level while the light green and yellow boxes represent similar trends but not statistically significant with probabilities (p values) between 0.05 and 0.15. These last two symbols are included to indicate which parks had trends that would have been considered statistically significant under the procedures used in past years. A significance level of .05 means there is a 5% chance of concluding there was a trend when in fact the change was due to chance.

02/04/2005

Figure 2

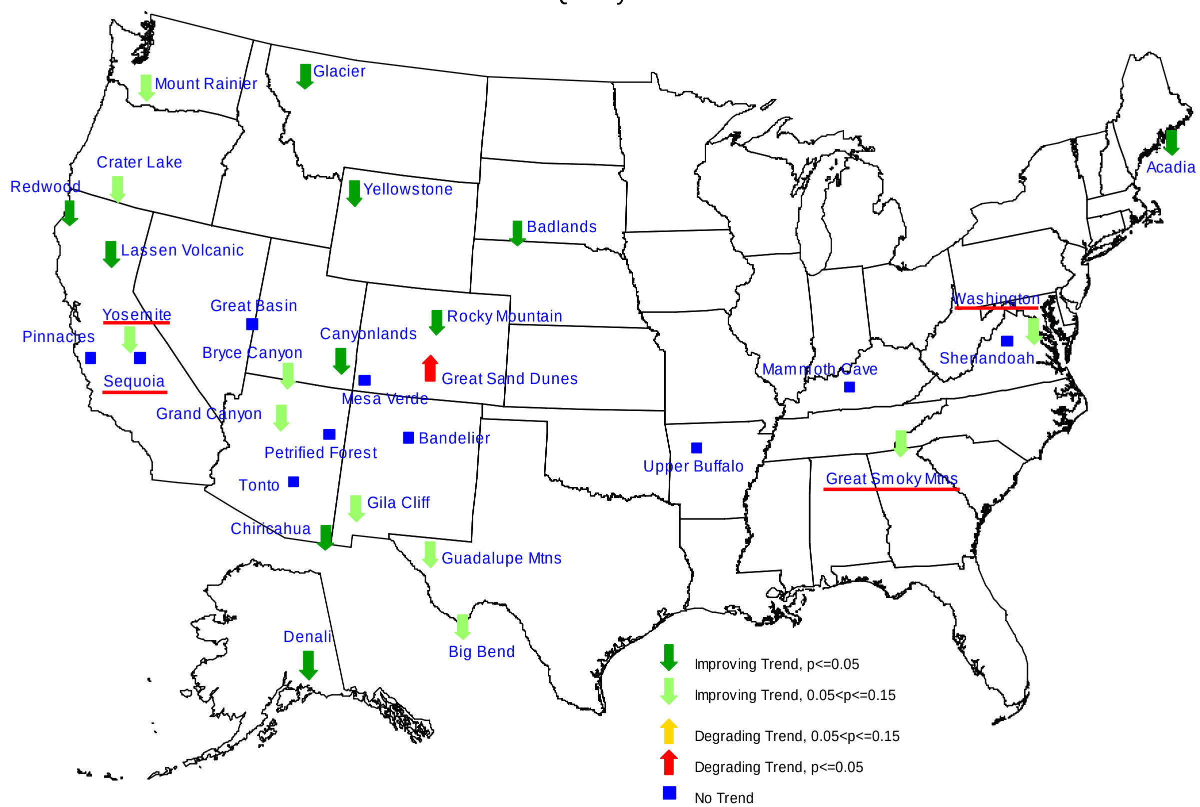


02/03/2005

Downward pointing arrows denote trends toward decreasing ozone concentrations and improving air quality. Similarly, the up arrows correspond to trends toward higher ozone concentrations and hence worsening air quality. Park names underlined in red denote parks where monitored ozone levels exceed the level of the NAAQS or are part of an ozone non-attainment area.

Figure 3

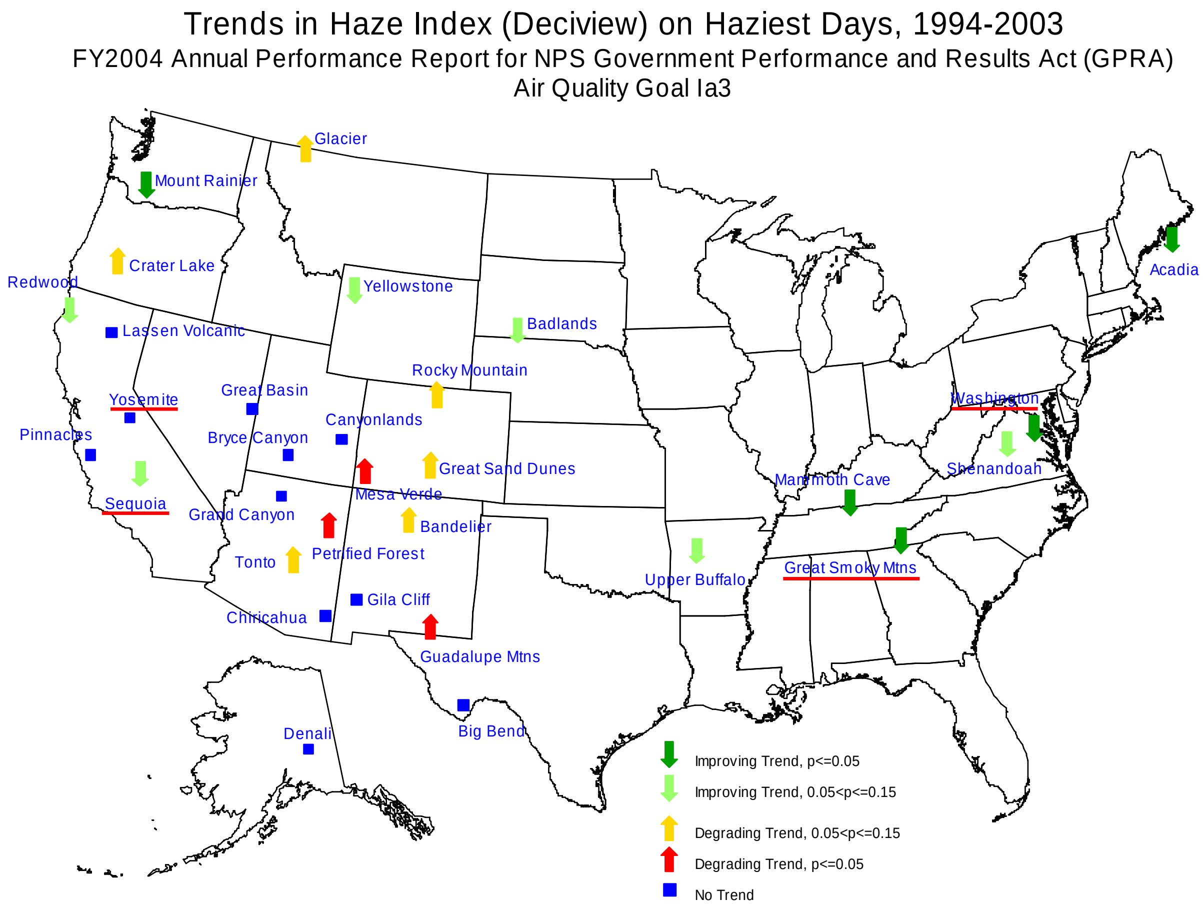
Trends in Haze Index (Deciview) on Clearest Days, 1994-2003
FY2004 Annual Performance Report for NPS Government Performance and Results Act (GPRA)
Air Quality Goal Ia3



02/03/2005

Downward pointing arrows denote trends toward decreasing haze index (deciview). Because the haze index is a measure of visibility impairment, with lower deciview levels corresponding to better visibility, a trend toward decreasing deciview means a trend toward improving air quality. Similarly, the up arrows correspond to trends toward higher values of deciview and hence worsening air quality. Park names underlined in red denote parks where monitored fine particulate matter (pm2.5) levels do not exceed the level of the NAAQS but are part of a pm2.5 non-attainment area.

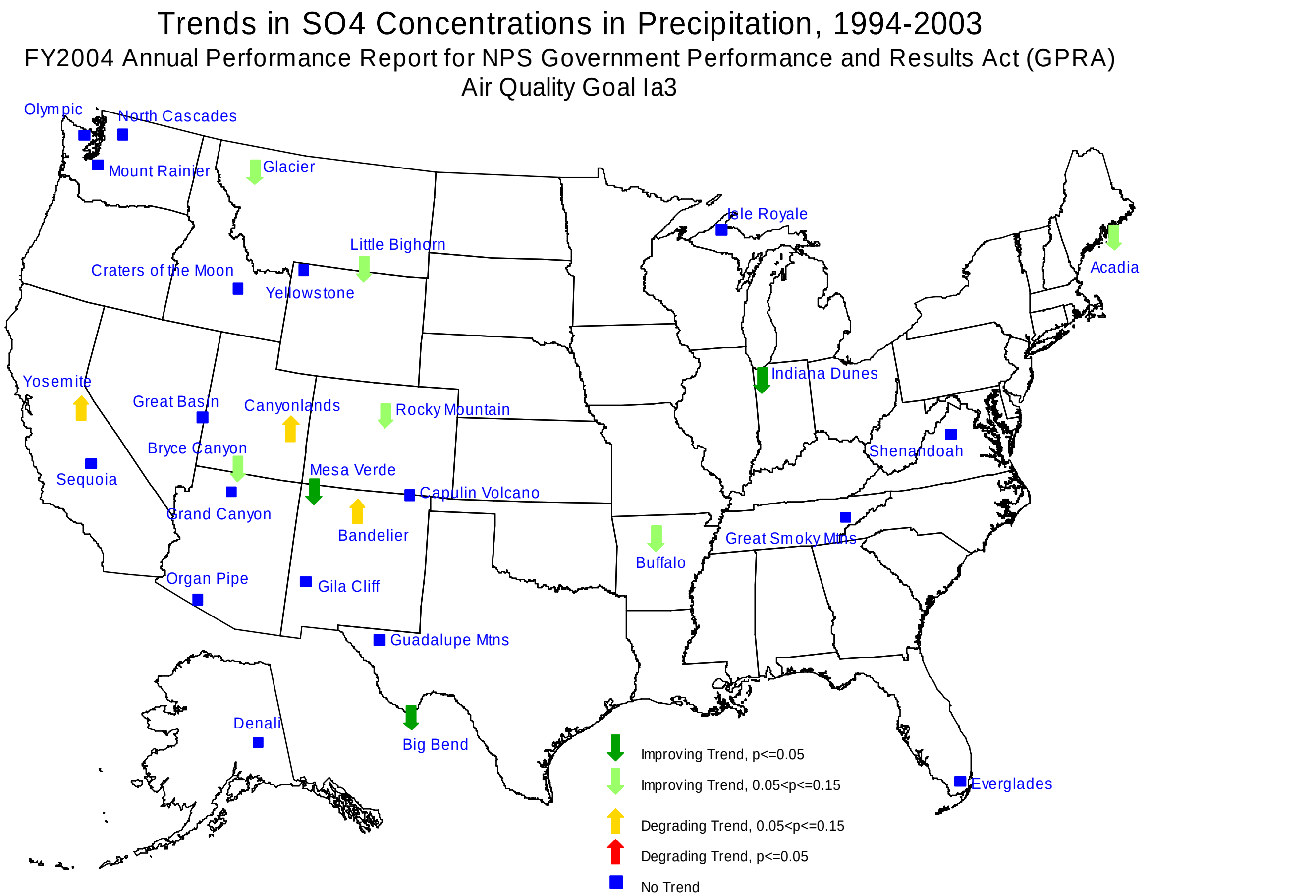
Figure 4



02/03/2005

Downward pointing arrows denote trends toward decreasing haze index (deciview). Because the haze index is a measure of visibility impairment, with lower deciview levels corresponding to better visibility, a trend toward decreasing deciview means a trend toward improving air quality. Similarly, the up arrows correspond to trends toward higher values of deciview and hence worsening air quality. Park names underlined in red denote parks where monitored fine particulate matter (pm2.5) levels do not exceed the level of the NAAQS but are part of a pm2.5 non-attainment area.

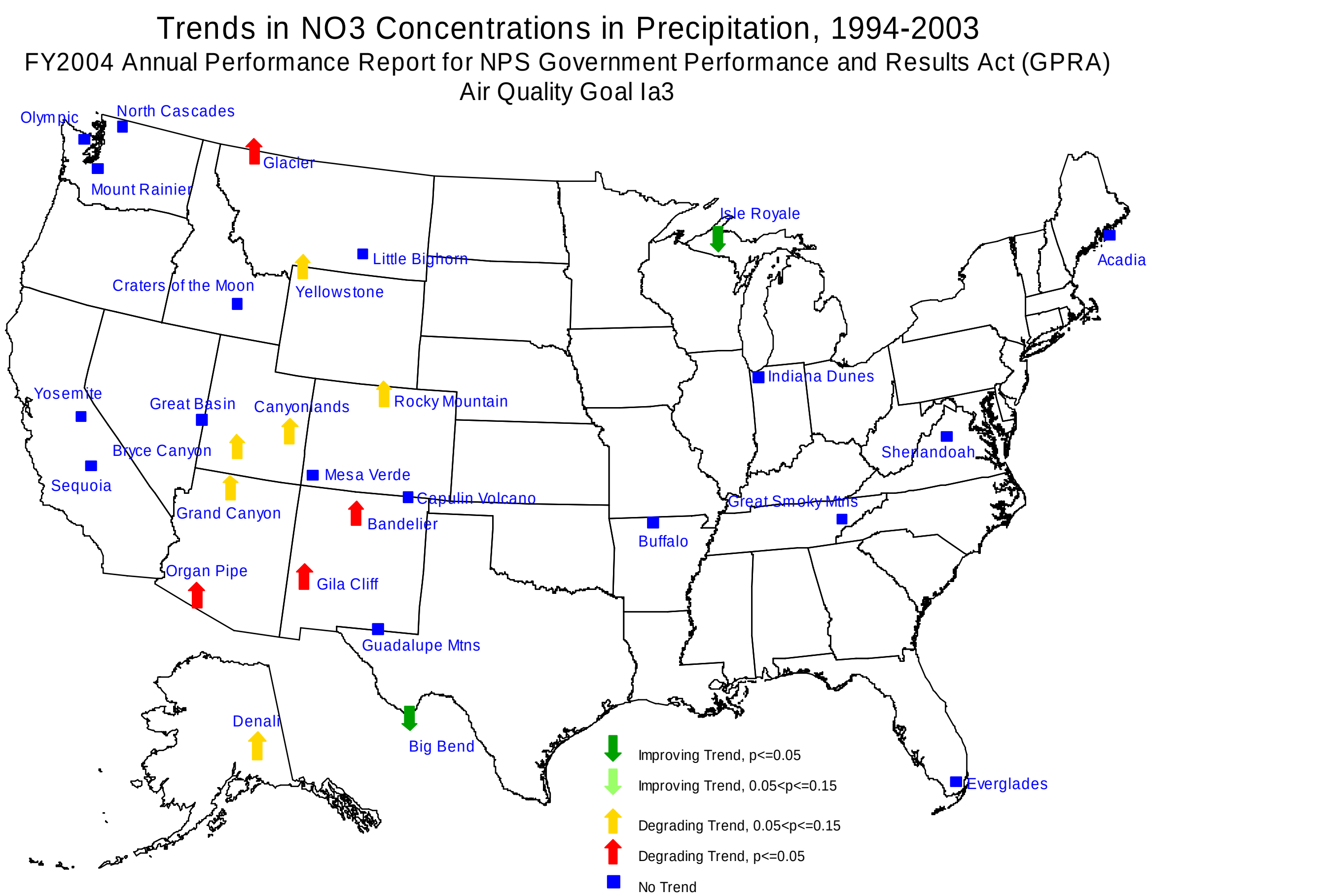
Figure 5



Downward pointing arrows denote trends toward decreasing sulfate (SO_4) concentrations and improving air quality. Similarly, the up arrows correspond to trends toward higher sulfate concentrations and hence worsening air quality.

02/03/2005

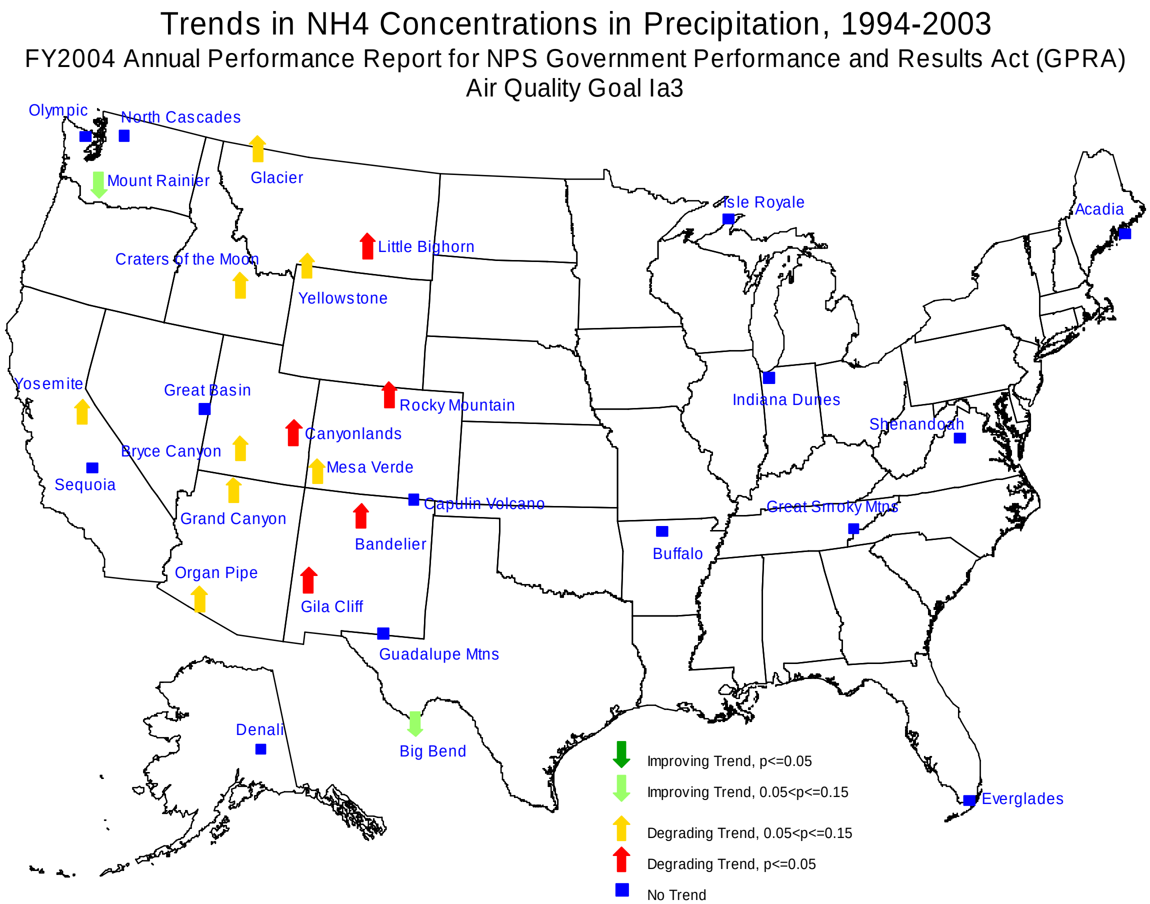
Figure 6



Downward pointing arrows denote trends toward decreasing nitrate (NO_3) concentrations and improving air quality. Similarly, the up arrows correspond to trends toward higher nitrate concentrations and hence worsening air quality.

02/03/2005

Figure 7

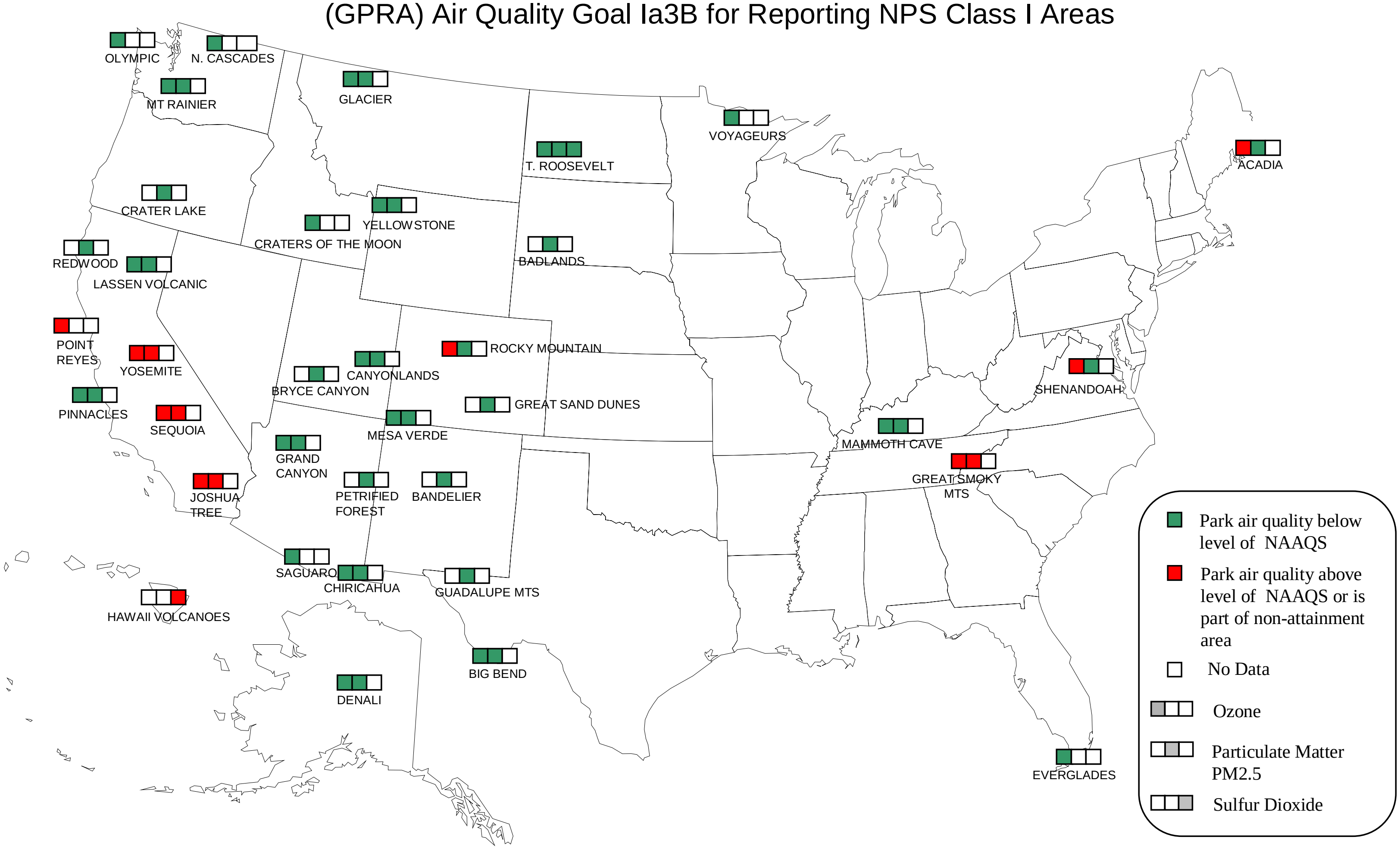


Downward pointing arrows denote trends toward decreasing ammonium (NH_4) concentrations and improving air quality. Similarly, the up arrows correspond to trends toward higher ammonium concentrations and hence worsening air quality.

02/03/2005

Figure 8

FY2004 Annual Performance Report for DOI/NPS Government Performance and Results Act (GPRA) Air Quality Goal Ia3B for Reporting NPS Class I Areas



02/01/2005